National Testing Agency

Question Paper Name :	B Tech 26 Jun 2022 Shift 2
Subject Name :	B. Tech
Duration :	180
Total Marks :	300
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	300

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 1 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let $f : R \to R$ be defined as $f(x) = x - 1$ and $g : R - \{1, -1\} \to R$ be defined as

$$g(x) = \frac{x^2}{x^2 - 1}$$

.

Then the function fog is :

Options :

A. one-one but not onto

B. onto but not one-one

C. both one-one and onto

D. neither one-one nor onto

Question Number : 2 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the system of equations

$\alpha x + y + z = 5, x + 2y + 3z = 4, x + 3y + 5z = \beta$

has infinitely many solutions, then the ordered pair (α, β) is equal to :

Options :

A. $(1, -3)$

B. $(-1, 3)$

C. $(1, 3)$

D. $(-1, -3)$

Question Number : 3 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

$$\lim_{x \to 0} \frac{\cos(\sin x) - \cos x}{x^4}$$

is equal to :

Options :

A. $\frac{1}{3}$

B. $\frac{1}{4}$

C. $\frac{1}{6}$

D. $\frac{1}{12}$

Question Number : 4 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let $f(x) = \min \{1, 1 + x \sin x\}, 0 \leq x \leq 2\pi$. If m is the number of points, where f is not differentiable and n is the number of points, where f is not continuous, then the ordered pair (m, n) is equal to

Options :

A. $(2, 0)$

B. $(1, 0)$

C. $(1, 1)$

D. (2, 1)

Question Number : 5 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Consider a cuboid of sides 2x, 4x and 5x and a closed hemisphere of radius r. If the sum of their surface areas is a constant k, then the ratio x : r, for which the sum of their volumes is maximum, is :

Options :

A. 2 : 5

B. 19 : 45

C. 3 : 8

D. 19 : 15

Question Number : 6 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The area of the region bounded by $y^2 = 8x$ and $y^2 = 16(3 - x)$ is equal to:

Options :

A. $\frac{32}{3}$

B. $\frac{40}{3}$

C. 16

D. 19

Question Number : 7 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If

$$\int \frac{1}{x}\sqrt{\frac{1-x}{1+x}}dx = g(x) + c$$

,

$$g(1) = 0$$

, then

$$g\left(\frac{1}{2}\right)$$

is equal to :

Options :

A. $\log_e\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)+\frac{\pi}{3}$

B. $\log_e\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)+\frac{\pi}{3}$

C. $\log_e\left(\frac{\sqrt{3}+1}{\sqrt{3}-1}\right)-\frac{\pi}{3}$

D. $\frac{1}{2}\log_e\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)-\frac{\pi}{6}$

Question Number : 8 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If

$$y = y(x)$$

is the solution of the differential equation

$$x\frac{dy}{dx} + 2y = x\,e^x$$

,

$$y(1) = 0$$

then the local maximum value

of the function

$$z(x) = x^2y(x) - e^x,\ x \in R$$

is :

Options :

A. $1 - \mathrm{e}$

B. 0

C. $\frac{1}{2}$

D. $\frac{4}{e} - e$

Question Number : 9 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the solution of the differential equation

$$\frac{dy}{dx} + e^x(x^2 - 2)y = (x^2 - 2x)(x^2 - 2)e^{2x}$$

satisfies

$$y(0) = 0$$

, then the value of y(2) is _____.

Options :

A. -1

B. 1

C. 0

D. e

Question Number : 10 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The locus of the mid point of the line segment joining the point (4, 3) and the points on the ellipse $x^2 + 2y^2 = 4$ is an ellipse with eccentricity :

Options :

A. $\frac{\sqrt{3}}{2}$

B. $\frac{1}{2\sqrt{2}}$

C. $\frac{1}{\sqrt{2}}$

D. $\frac{1}{2}$

Question Number : 11 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let

$$\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$$

,

$$\vec{b} = 2\hat{i} - 3\hat{j} + \hat{k}$$

and

$$\vec{c} = \hat{i} - \hat{j} + \hat{k}$$

be three given vectors. Let $\vec{v}$ be a vector in the plane of $\vec{a}$ and $\vec{b}$ whose projection on $\vec{c}$ is

$$\frac{2}{\sqrt{3}}$$

. If

$$\vec{v} \cdot \hat{j} = 7$$

, then $\vec{v} \cdot \left(\hat{i} + \hat{k}\right)$ is equal to :

Options :

A. 6

B. 7

C. 8

D. 9

Question Number : 12 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The mean and standard deviation of 50 observations are 15 and 2 respectively. It was found that one incorrect observation was taken such that the sum of correct and incorrect observations is 70. If the correct mean is 16, then the correct variance is equal to :

Options :

A. 10

B. 36

C. 43

D. 60

Question Number : 13 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

$16\sin(20^\circ)\sin(40^\circ)\sin(80^\circ)$ is equal to :

Options :

A. $\sqrt{3}$

B. $2\sqrt{3}$

C. 3

D. $4\sqrt{3}$

Question Number : 14 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the inverse trigonometric functions take principal values then

$$\cos^{-1}\left(\frac{3}{10}\cos\left(\tan^{-1}\left(\frac{4}{3}\right)\right)+\frac{2}{5}\sin\left(\tan^{-1}\left(\frac{4}{3}\right)\right)\right)$$

is equal to :

Options :

A. 0

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{6}$

Question Number : 15 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If

$$A=\sum_{n=1}^{\infty}\frac{1}{\left(3+(-1)^n\right)^n}$$

and

$$B=\sum_{n=1}^{\infty}\frac{(-1)^n}{\left(3+(-1)^n\right)^n}$$

, then

$$\frac{A}{B}$$

is equal to :

Options :

A. $\frac{11}{9}$

B. 1

C. $-\frac{11}{9}$

D. $-\frac{11}{3}$

Question Number : 16 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If m is the slope of a common tangent to the curves

$$\frac{x^2}{16}+\frac{y^2}{9}=1$$

and $x^2+y^2=12$, then $12m^2$ is equal to :

Options :

A. 6

B. 9

C. 10

D. 12

Question Number : 17 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The normal to the hyperbola

$$\frac{x^2}{a^2}-\frac{y^2}{9}=1$$

at the point $\left(8,3\sqrt{3}\right)$ on it passes through the point :

Options :

A. $\left(15,-2\sqrt{3}\right)$

B. $\left(9,2\sqrt{3}\right)$

C. $\left(-1,9\sqrt{3}\right)$

D. $\left(-1,6\sqrt{3}\right)$

Question Number : 18 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the plane $2x + y - 5z = 0$ is rotated about its line of intersection with the plane $3x - y + 4z - 7 = 0$ by an angle of $\frac{\pi}{2}$, then the plane after the rotation passes through the point :

Options :

A. $(2, -2, 0)$

B. $(-2, 2, 0)$

C. $(1, 0, 2)$

D. $(-1, 0, -2)$

Question Number : 19 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the lines

$$\vec{r} = \left(\hat{i} - \hat{j} + \hat{k}\right) + \lambda\left(3\hat{j} - \hat{k}\right)$$

and

$$\vec{r} = \left(\alpha\hat{i} - \hat{j}\right) + \mu\left(2\hat{i} - 3\hat{k}\right)$$

are co-planar, then the distance of the plane containing these two lines from the point $(\alpha, 0, 0)$ is :

Options :

A. $\frac{2}{9}$

B. $\frac{2}{11}$

C. $\frac{4}{11}$

D. 2

Question Number : 20 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let $r \in \{p, q, \sim p, \sim q\}$ be such that the logical statement

$r \vee (\sim p) \Rightarrow (p \wedge q) \vee r$

is a tautology. Then r is equal to :

Options :

A. p

B. q

C. $\sim p$

D. $\sim q$

Mathematics Section B

Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 21 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let $f : R \to R$ satisfy

$$f(x+y) = 2^x f(y) + 4^y f(x)$$

, $\forall x, y \in R$. If $f(2) = 3$, then

$$14.\ \frac{f'(4)}{f'(2)}$$

is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 22 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let p and q be two real numbers such that $p + q = 3$ and $p^4 + q^4 = 369$. Then

$$\left(\frac{1}{p} + \frac{1}{q}\right)^{-2}$$

is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 23 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

If $z^2 + z + 1 = 0, z \in C$, then

$$\left|\sum_{n=1}^{15}\left(z^n + (-1)^n \frac{1}{z^n}\right)^2\right|$$

is equal to _____.

Response Type : Numeric

Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 24 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let

$$X = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}, \; Y = \alpha I + \beta X + \gamma X^2$$

and

$$Z = \alpha^2 I - \alpha\beta X + (\beta^2 - \alpha\gamma)X^2$$

, $\alpha, \beta, \gamma \in$ R. If

$$Y^{-1} = \begin{bmatrix} \frac{1}{5} & \frac{-2}{5} & \frac{1}{5} \\ 0 & \frac{1}{5} & \frac{-2}{5} \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$$

, then $(\alpha - \beta + \gamma)^2$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 25 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The total number of 3-digit numbers, whose greatest common divisor with 36 is 2, is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 26 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

If a_1 (> 0), a_2, a_3, a_4, a_5 are in a G.P., $a_2 + a_4 = 2a_3 + 1$ and $3a_2 + a_3 = 2a_4$, then $a_2 + a_4 + 2a_5$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 27 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The integral

$$\frac{24}{\pi}\int_0^{\sqrt{2}} \frac{(2 - x^2)dx}{(2 + x^2)\sqrt{4 + x^4}}$$

is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes

Answers Type : Equal
Text Areas : PlainText

Question Number : 28 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

If the probability that a randomly chosen 6-digit number formed by using digits 1 and 8 only is a multiple of 21 is p, then 96 p is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 29 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

If

$$\left({}^{40}C_0\right) + \left({}^{41}C_1\right) + \left({}^{42}C_2\right) + \ ..... \ + \ \left({}^{60}C_{20}\right) = \frac{m}{n}{}^{60}C_{20}$$

m and n are coprime, then m + n is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 30 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Let a line L_1 be tangent to the hyperbola

$$\frac{x^2}{16} - \frac{y^2}{4} = 1$$

and let L_2 be the line passing through the origin and perpendicular to L_1. If the locus of the point of intersection of L_1 and L_2 is

$$(x^2 + y^2)^2 = \alpha x^2 + \beta y^2$$

, then $\alpha + \beta$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Physics Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 31 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The dimension of mutual inductance is :

Options :

A. $[ML^2T^{-2}A^{-1}]$

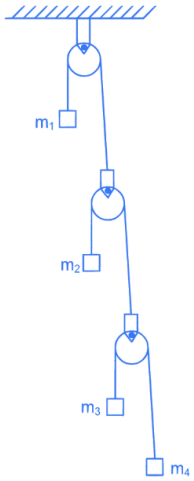
B. $[ML^2T^{-3}A^{-1}]$

C. $[ML^2T^{-2}A^{-2}]$

D. $[ML^2T^{-3}A^{-2}]$

Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

In the arrangement shown in figure a_1, a_2, a_3 and a_4 are the accelerations of masses m_1, m_2, m_3 and m_4 respectively. Which of the following relation is true for this arrangement?



Options :

A. $4a_1 + 2a_2 + a_3 + a_4 = 0$

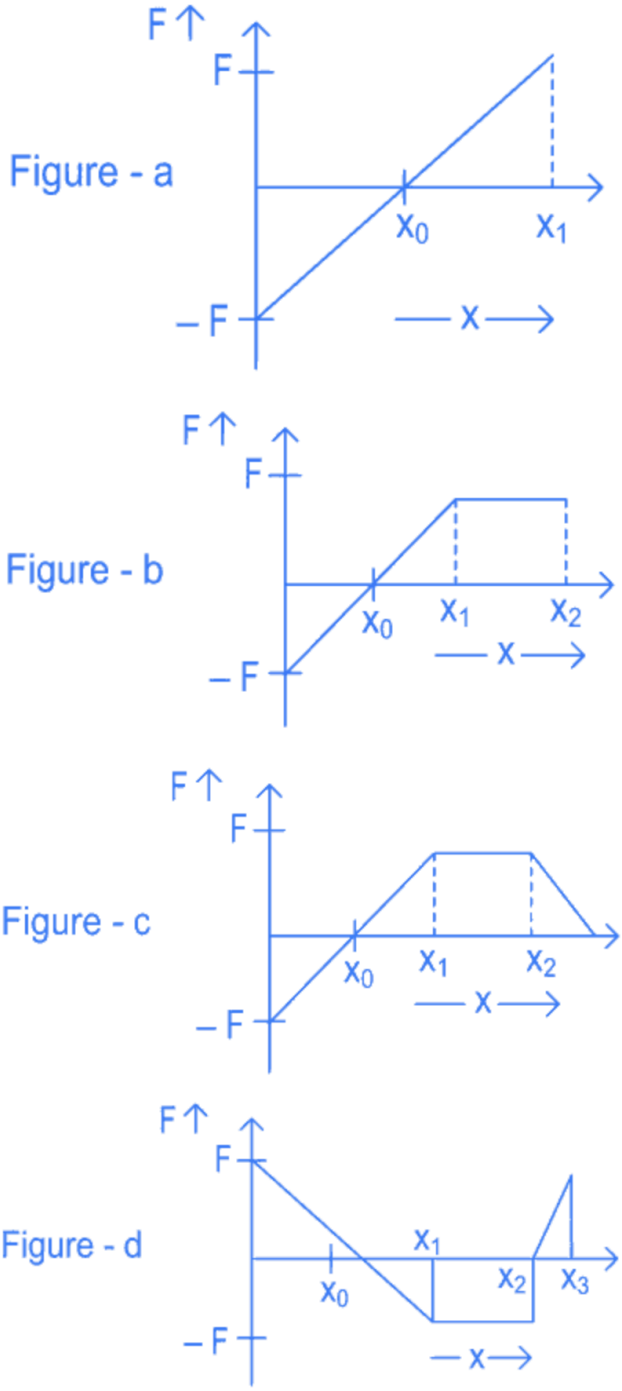
B. $a_1 + 4a_2 + 3a_3 + a_4 = 0$

C. $a_1 + 4a_2 + 3a_3 + 2a_4 = 0$

D. $2a_1 + 2a_2 + 3a_3 + a_4 = 0$

Question Number : 33 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Arrange the four graphs in descending order of total work done; where W_1, W_2, W_3 and W_4 are the work done corresponding to figure a, b, c and d respectively.



Options :

A. $W_3 > W_2 > W_1 > W_4$

B. $W_3 > W_2 > W_4 > W_1$

C. $W_2 > W_3 > W_4 > W_1$

D. $W_2 > W_3 > W_1 > W_4$

Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A solid spherical ball is rolling on a frictionless horizontal plane surface about its axis of symmetry. The ratio of rotational kinetic energy of the ball to its total kinetic energy is

Options :

A. $\frac{2}{5}$

B. $\frac{2}{7}$

C. $\frac{1}{5}$

D. $\frac{7}{10}$

Question Number : 35 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : If we move from poles to equator, the direction of acceleration due to gravity of earth always points towards the center of earth without any variation in its magnitude.

Reason R : At equator, the direction of acceleration due to the gravity is towards the center of earth.

In the light of above statements, choose the correct answer from the options given below:

Options :

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true but R is NOT the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Question Number : 36 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If p is the density and η is coefficient of viscosity of fluid which flows with a speed v in the pipe of diameter d, the correct formula for Reynolds number R_e is :

Options :

A. $R_e = \frac{\eta d}{\rho v}$

B. $R_e = \frac{\rho v}{\eta d}$

C. $R_e = \frac{\rho v d}{\eta}$

D. $R_e = \frac{\eta}{\rho v d}$

Question Number : 37 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A flask contains argon and oxygen in the ratio of 3 : 2 in mass and the mixture is kept at 27°C. The ratio of their average kinetic energy per molecule respectively will be :

Options :

A. 3 : 2

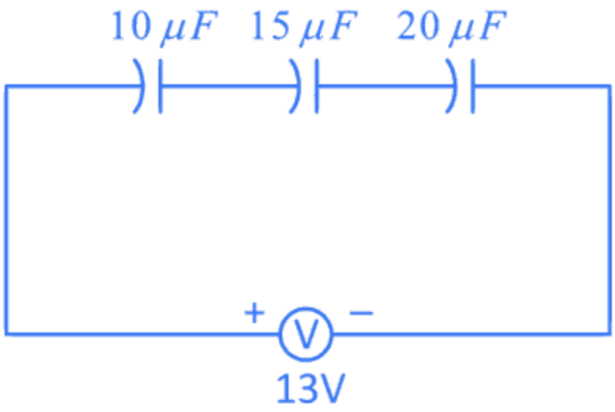
B. 9 : 4

C. 2 : 3

D. 1 : 1

Question Number : 38 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The charge on capacitor of capacitance 15μF in the figure given below is :



Options :

A. 60μc

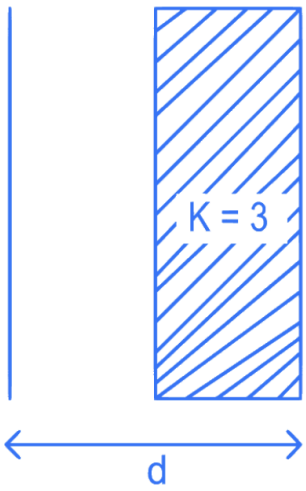
B. 130μc

C. 260μc

D. 585μc

Question Number : 39 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A parallel plate capacitor with plate area A and plate separation d = 2 m has a capacitance of 4 μF. The new capacitance of the system if half of the space between them is filled with a dielectric material of dielectric constant K = 3 (as shown in figure) will be :



Options :

A. $2\mu F$

B. $32\mu F$

C. $6\mu F$

D. $8\mu F$

Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Sixty four conducting drops each of radius 0.02 m and each carrying a charge of 5 μC are combined to form a bigger drop. The ratio of surface density of bigger drop to the smaller drop will be :

Options :

A. 1 : 4

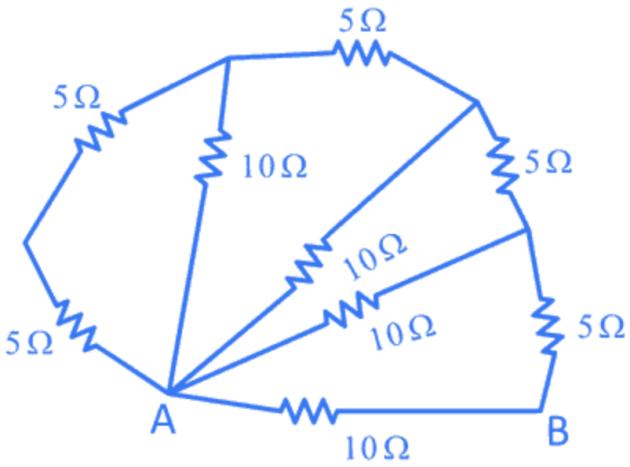
B. 4 : 1

C. 1 : 8

D. 8 : 1

Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The equivalent resistance between points A and B in the given network is :



Options :

A. 65Ω

B. 20Ω

C. 5Ω

D. 2Ω

Question Number : 42 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A bar magnet having a magnetic moment of 2.0×10^5 JT^{-1}, is placed along the direction of uniform magnetic field of magnitude $B = 14 \times 10^{-5}$ T. The work done in rotating the magnet slowly through 60° from the direction of field is :

Options :

A. 14 J

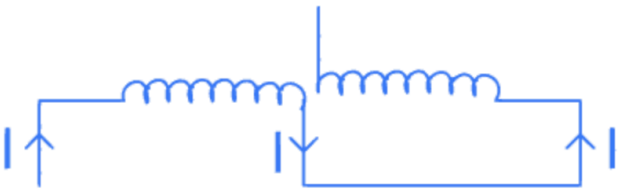
B. 8.4 J

C. 4 J

D. 1.4 J

Question Number : 43 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Two coils of self inductance L_1 and L_2 are connected in series combination having mutual inductance of the coils as M. The equivalent self inductance of the combination will be :



Options :

A. $\frac{1}{L_1}+\frac{1}{L_2}+\frac{1}{M}$

B. L_1+L_2+M

C. L_1+L_2+2M

D. L_1+L_2-2M

Question Number : 44 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A metallic conductor of length 1 m rotates in a vertical plane parallel to east-west direction about one of its end with angular velocity 5 rad s^{-1}. If the horizontal component of earth's magnetic field is 0.2×10^{-4} T, then emf induced between the two ends of the conductor is :

Options :

A. $5\ \mu V$

B. $50\ \mu V$

C. 5 mV

D. 50 mv

Question Number : 45 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which is the correct ascending order of wavelengths?

Options :

A. $\lambda_{\text{visible}} < \lambda_{\text{X-ray}} < \lambda_{\text{gamma-ray}} < \lambda_{\text{microwave}}$

B. $\lambda_{\text{gamma-ray}} < \lambda_{\text{X-ray}} < \lambda_{\text{visible}} < \lambda_{\text{microwave}}$

C. $\lambda_{\text{X-ray}} < \lambda_{\text{gamma-ray}} < \lambda_{\text{visible}} < \lambda_{\text{microwave}}$

D. $\lambda_{\text{microwave}} < \lambda_{\text{visible}} < \lambda_{\text{gamma-ray}} < \lambda_{\text{X-ray}}$

Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

For a specific wavelength 670 nm of light coming from a galaxy moving with velocity v, the observed wavelength is 670.7 nm. The value of v is :

Options :

A. $3 \times 10^8\ \text{ms}^{-1}$

B. $3 \times 10^{10}\ \text{ms}^{-1}$

C. $3.13 \times 10^5\ \text{ms}^{-1}$

D. $4.48 \times 10^5\ \text{ms}^{-1}$

Question Number : 47 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A metal surface is illuminated by a radiation of wavelength 4500 $\overset{o}{\text{A}}$. The ejected photo-electron enters a constant magnetic field of 2 mT making an angle of 90° with the magnetic field. If it starts revolving in a circular path of radius 2 mm, the work function of the metal is approximately :

Options :

A. 1.36 eV

B. 1.69 eV

C. 2.78 eV

D. 2.23 eV

Question Number : 48 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A radioactive nucleus can decay by two different processes. Half-life for the first process is 3.0 hours while it is 4.5 hours for the second process. The effective half-life of the nucleus will be:

Options :

A. 3.75 hours

B. 0.56 hours

C. 0.26 hours

D. 1.80 hours

Question Number : 49 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The positive feedback is required by an amplifier to act an oscillator. The feedback here means :

Options :

A. External input is necessary to sustain ac signal in output.

B. A portion of the output power is returned back to the input.

C. Feedback can be achieved by LR network.

D. The base-collector junction must be forward biased.

Question Number : 50 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A sinusoidal wave $y(t) = 40\sin(10 \times 10^6 \pi t)$ is amplitude modulated by another sinusoidal wave $x(t) = 20\sin(1000 \pi t)$. The amplitude of minimum frequency component of modulated signal is :

Options :

A. 0.5

B. 0.25

C. 20

D. 10

Physics Section B

Section Number :	4
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 51 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A ball is projected vertically upward with an initial velocity of 50 ms^{-1} at t = 0s. At t = 2s, another ball is projected vertically upward with same velocity. At t = _____ s, second ball will meet the first ball (g = 10 ms^{-2}).

Response Type : Numeric

Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

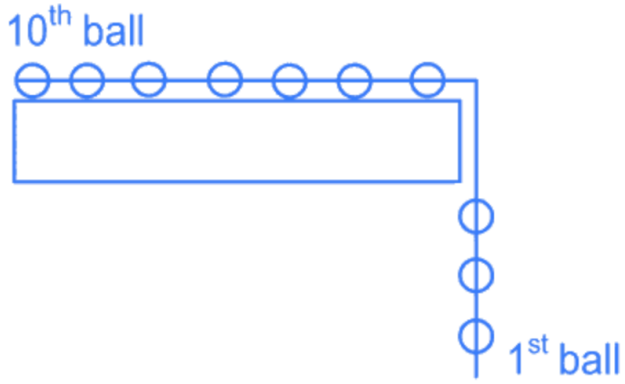
Question Number : 52 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A batsman hits back a ball of mass 0.4 kg straight in the direction of the bowler without changing its initial speed of 15 ms^{-1}. The impulse imparted to the ball is _____ Ns.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 53 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A system to 10 balls each of mass 2 kg are connected via massless and unstretchable string. The system is allowed to slip over the edge of a smooth table as shown in figure. Tension on the string between the 7^{th} and 8^{th} ball is _____ N when 6^{th} ball just leaves the table.



Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 54 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A geyser heats water flowing at a rate of 2.0 kg per minute from 30°C to 70°C. If geyser operates on a gas burner, the rate of combustion of fuel will be _____ g min^{-1}.

[Heat of combustion = 8×10^3 Jg^{-1}, Specific heat of water = 4.2 Jg^{-1} $°C^{-1}$]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 55 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A set of 20 tuning forks is arranged in a series of increasing frequencies. If each fork gives 4 beats with respect to the preceding fork and the frequency of the last fork is twice the frequency of the first, then the frequency of last fork is _____ Hz.

Response Type : Numeric
Evaluation Required For SA : Yes

Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 56 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Two 10 cm long, straight wires, each carrying a current of 5A are kept parallel to each other. If each wire experienced a force of 10^{-5} N, then separation between the wires is _____ cm.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 57 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A small bulb is placed at the bottom of a tank containing water to a depth of $\sqrt{7}$ m. The refractive index of water is $\frac{4}{3}$. The area of the surface of water through which light from the bulb can emerge out is $x\pi$ m^2. The value of x is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 58 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A travelling microscope is used to determine the refractive index of a glass slab. If 40 divisions are there in 1 cm on main scale and 50 Vernier scale divisions are equal to 49 main scale divisions, then least count of the travelling microscope is _____ $\times 10^{-6}$ m.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 59 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The stopping potential for photoelectrons emitted from a surface illuminated by light of wavelength 6630 $\overset{o}{A}$ is 0.42 V. If the threshold frequency is $x \times 10^{13}$ /s, where x is _____ (nearest integer).

(Given, speed light = 3×10^8 m/s, Planck's constant = 6.63×10^{-34} Js)

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 60 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A heat engine operates with the cold reservoir at temperature 324 K. The minimum temperature of the hot reservoir, if the heat engine takes 300 J heat from the hot reservoir and delivers 180 J heat to the cold reservoir per cycle, is _____ K.

Response Type : Numeric
Evaluation Required For SA : Yes

Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Chemistry Section A

Section Number :	5
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 61 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The number of radial and angular nodes in 4d orbital are, respectively

Options :

A. 1 and 2

B. 3 and 2

C. 1 and 0

D. 2 and 1

Question Number : 62 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Match List-I with List-II

	List - I Enzyne		**List - II Conversion of**
A.	Invertase	I.	Starch into maltose
B.	Zymase	II.	Maltose into glucose
C.	Diastase	III.	Glucose into ethanol
D.	Maltase	IV.	Cane sugar into glucose

Choose the most appropriate answer from the options given below :

Options :

A. A-III, B-IV, C-II, D-I

B. A-III, B-II, C-I, D-IV

C. A-IV, B-III, C-I, D-II

D. A-IV, B-II, C-III, D-I

Question Number : 63 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the following elements is considered as a metalloid?

Options :

A. Sc

B. Pb

C. Bi

D. Te

Question Number : 64 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The oxide which contains an odd electron at the nitrogen atom is :

Options :

A. N_2O

B. NO_2

C. N_2O_3

D. N_2O_5

Question Number : 65 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which one of the following is an example of disproportionation reaction ?

Options :

A. $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

B. $MnO_4^- + 4H^+ + 4e^- \rightarrow MnO_2 + 2H_2O$

C. $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$

D. $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

Question Number : 66 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The most common oxidation state of Lanthanoid elements is +3. Which of the following is likely to deviate easily from +3 oxidation state?

Options :

A. Ce (At. No. 58)

B. La (At. No. 57)

C. Lu (At. No. 71)

D. Gd (At. No. 64)

Question Number : 67 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The correct order of nucleophilicity is

Options :

A. $F^- > OH^-$

B. 

C. 

D. $NH_2^- > NH_3$

Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Oxidation of toluene to benzaldehyde can be easily carried out with which of the following reagents?

Options :

A. CrO_3/acetic acid, H_3O^+

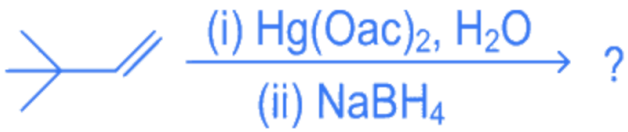
B. CrO_3/acetic anhydride, H_3O^+

C. $KMnO_4$/HCl, H_3O^+

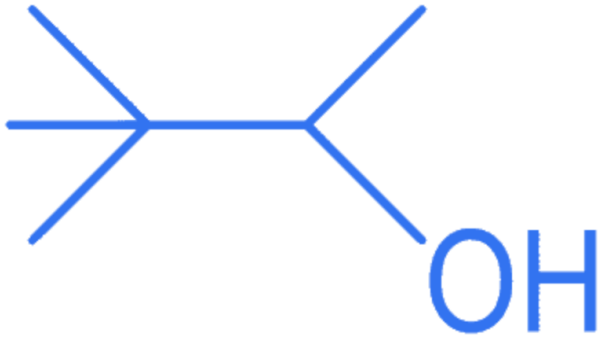
D. CO/HCl, anhydrous $AlCl_3$

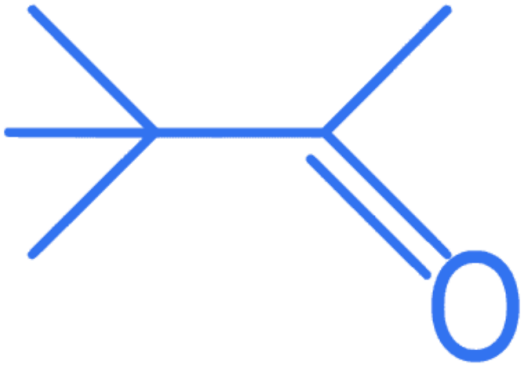
Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

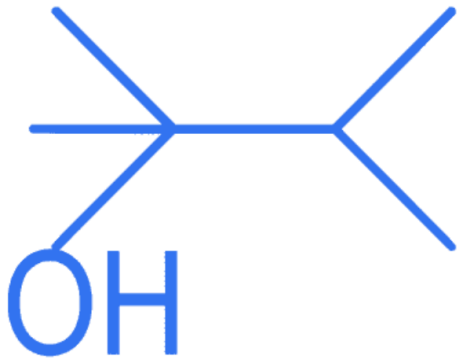
The major product in the following reaction



Options :

A. 

B. 

C. 

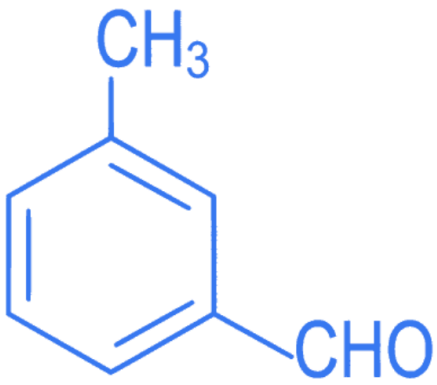
D. 

Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

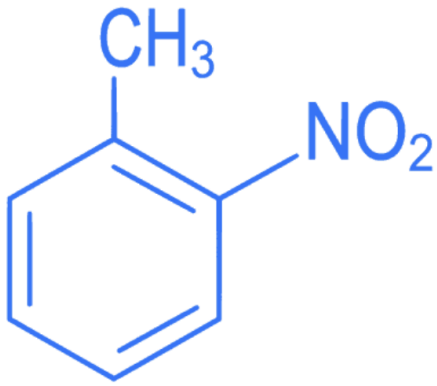
Halogenation of which one of the following will yield m-substituted product with respect to methyl group as a major product?

Options :

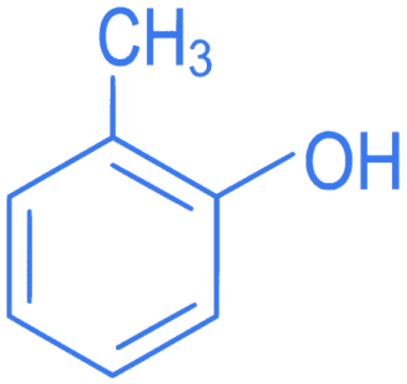
A.



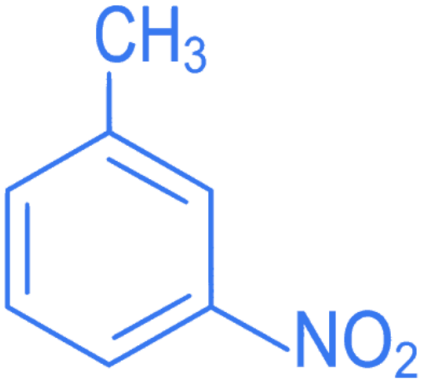
B.



C.

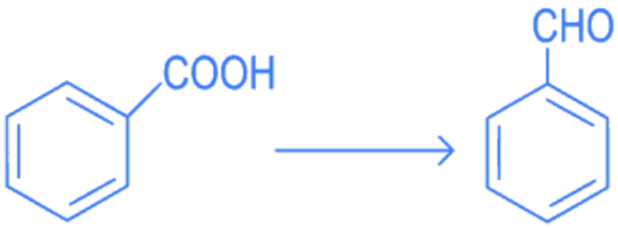


D.



Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The reagent, from the following, which converts benzoic acid to benzaldehyde in one step is



Options :

A. $LiAlH_4$

B. $KMnO_4$

C. MnO

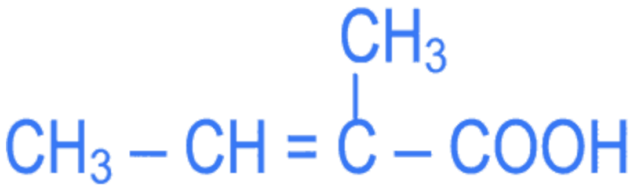
D. $NaBH_4$

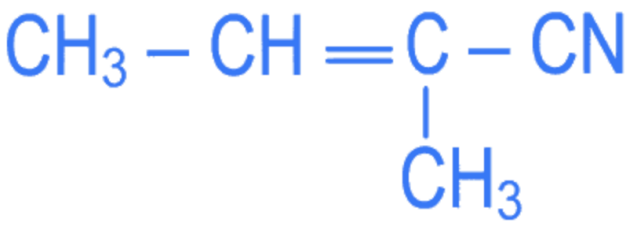
Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

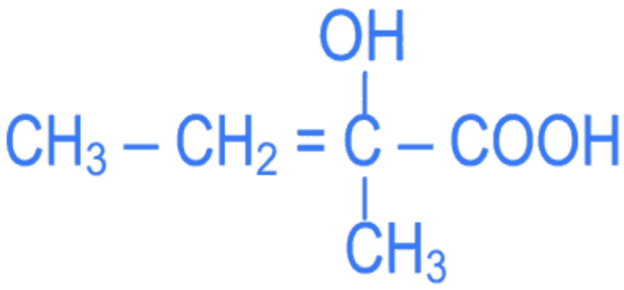
The final product 'A' in the following reaction sequence



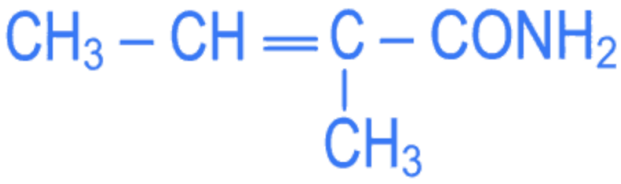
Options :

A. 

B. 

C. 

D.



Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which statement is NOT correct for p-toluenesulphonyl chloride?

Options :

A. It is known as Hinsberg's reagent.

B. It is used to distinguish primary and secondary amines.

C. On treatment with secondary amine, it leads to a product, that is soluble in alkali.

D. It doesn't react with tertiary amines.

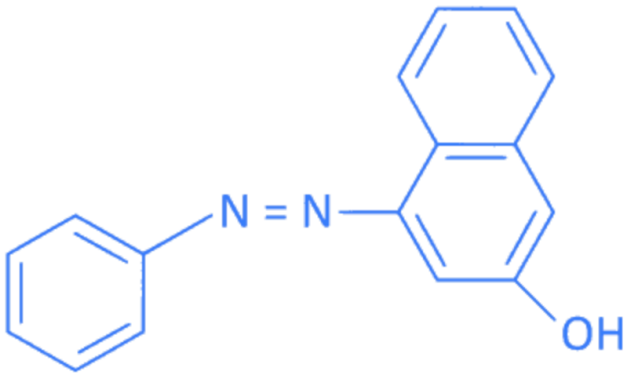
Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The final product 'C' in the following series of reactions

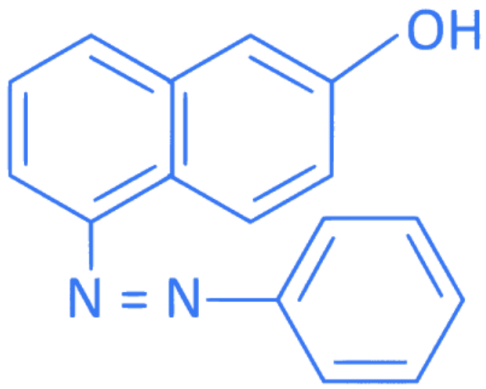


Options :

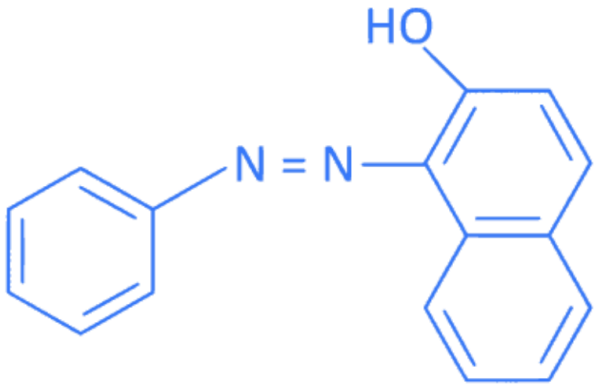
A.



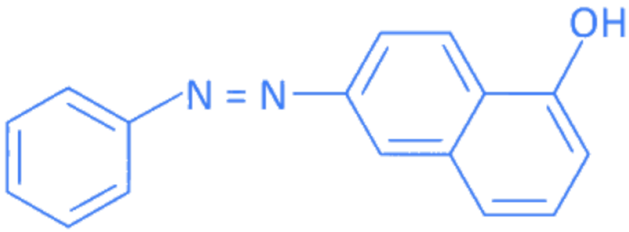
B.



C.



D.



Question Number : 75 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which one of the following is a water soluble vitamin, that is not excreted easily?

Options :

A. Vitamin B_2

B. Vitamin B_1

C. Vitamin B_6

D. Vitamin B_{12}

Question Number : 76 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The role of depressants in 'Froth Flotation method' is to

Options :

A. selectively prevent one component of the ore from coming to the froth.

B. reduce the consumption of oil for froth formation.

C. stabilize the froth.

D. enhance non-wettability of the mineral particles.

Question Number : 77 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Boiling of hard water is helpful in removing the temporary hardness by converting calcium hydrogen carbonate and magnesium hydrogen carbonate to :

Options :

A. $CaCO_3$ and $Mg(OH)_2$

B. $CaCO_3$ and $MgCO_3$

C. $Ca(OH)_2$ and $MgCO_3$

D. $Ca(OH)_2$ and $Mg(OH)_2$

Question Number : 78 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

s-block element which cannot be qualitatively confirmed by the flame test is :

Options :

A. Li

B. Na

C. Rb

D. Be

Question Number : 79 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The measured BOD values for four different water samples (A-D) are as follows: A = 3 ppm; B = 18 ppm; C = 21 ppm; D = 4 ppm. The water samples which can be called as highly polluted with organic wastes, are :

Options :

A. A and B

B. A and D

C. B and C

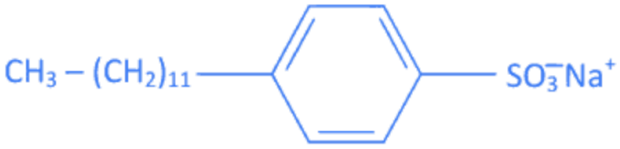
D. B and D

Question Number : 80 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the following is NOT an example of synthetic detergent?

Options :

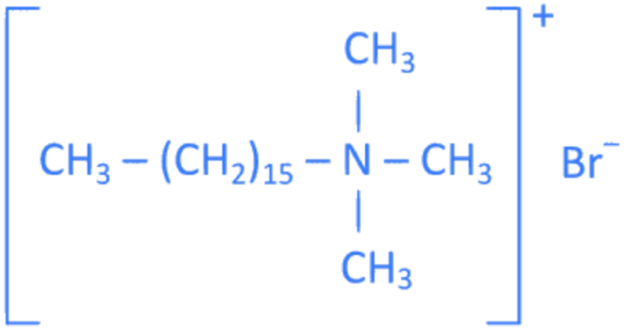
A.



B.

$$CH_3 - (CH_2)_{16} - COO^-Na^+$$

C.



D.

$$CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$$

Chemistry Section B

Section Number :	6
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 81 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

CNG is an important transportation fuel. When 100 g CNG is mixed with 208 g oxygen in vehicles, it leads to the formation of CO_2 and H_2O and produces large quantity of heat during this combustion, then the amount of carbon dioxide, produced in grams is _____. [nearest integer]

[Assume CNG to be methane]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 82 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Amongst SF_4, XeF_4, CF_4 and H_2O, the number of species with two lone pairs of electrons is _____.

Response Type : Numeric
Evaluation Required For SA : Yes

Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 83 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

A fish swimming in water body when taken out from the water body is covered with a film of water of weight 36 g. When it is subjected to cooking at 100°C, then the internal energy for vaporization in kJ mol^{-1} is _____. [nearest integer]

[Assume steam to be an ideal gas. Given $\Delta_{vap}H^{\Theta}$ for water at 373 K and 1 bar is 41.1 kJ mol^{-1} ; R = 8.31 J K^{-1} mol^{-1}]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 84 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The osmotic pressure exerted by a solution prepared by dissolving 2.0 g of protein of molar mass 60 kg mol^{-1} in 200 mL of water at 27°C is _____ Pa. [integer value]

(use R = 0.083 L bar mol^{-1} K^{-1})

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 85 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

40% of HI undergoes decomposition to H_2 and I_2 at 300 K. ΔG^{Θ} for this decomposition reaction at one atmosphere pressure is _____ J mol^{-1}. [nearest integer]

(Use R = 8.31 J K^{-1} mol^{-1} ; log 2 = 0.3010, ln 10 = 2.3, log 3 = 0.477)

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 86 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

$Cu(s) + Sn^{2+}(0.001M) \rightarrow Cu^{2+}(0.01M) + Sn(s)$

The Gibbs free energy change for the above reaction at 298 K is $x \times 10^{-1}$ kJ mol^{-1}. The value of x is _____. [nearest integer]

[Given :

$$E^{\Theta}_{Cu^{2+}/Cu} = 0.34\,V$$

;

$$E^{\Theta}_{Sn^{2+}/Sn} = -0.14\,V$$

; F = 96500 C mol^{-1}]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 87 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Catalyst A reduces the activation energy for a reaction by 10 kJ mol^{-1} at 300 K. The ratio of rate constants,

$$\frac{^{k}T,\ Catalysed}{^{k}T,\ Uncatalysed}$$

is e^{x}. The value of x is _____. [nearest integer]

[Assume that the pre-exponential factor is same in both the cases. Given R = 8.31 J K^{-1} mol^{-1}]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 88 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

Reaction of $[Co(H_2O)_6]^{2+}$ with excess ammonia and in the presence of oxygen results into a diamagnetic product. Number of electrons present in t_{2g}-orbitals of the product is _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 89 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

The moles of methane required to produce 81 g of water after complete combustion is _____ $\times 10^{-2}$ mol. [nearest integer]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText

Question Number : 90 Question Type : SA Display Question Number : Yes Keyboard Layout : Inscript

In a solid AB, A atoms are in ccp arrangement and B atoms occupy all the octahedral sites. If two atoms from the opposite faces are removed, then the resultant stoichiometry of the compound is A_xB_y. The value of x is _____. [nearest integer]

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText